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<p>(54) Title: <b>THERMOFORMING APPARATUS FOR THERMOFORMABLE MATERIALS IN RIBBON OR SHEET-FORM</b></p>		
<p>(57) Abstract</p> <p>A thermoforming apparatus comprising a thermoforming machine (10) having a female die (12) and counter-die or male die (13) reciprocally approachable and removable for the operations of closing, thermoforming and opening, a feeder of thermoforming material between the female die (12) and counter-die (13), cutting means for cutting the thermoforming material immediately after the closure of the female die and the counter-die, one or more work or treatment stations for the articles (15) thermoformed in the die (12), extraction heads (16) arranged to be operated concomitantly with each opening of the same to extract a thermoformed article (15) moulding from the female die and to convey the articles thus extracted to one or more work or treatment stations or else to transfer them to a receiving template (17), retention means for engaging each thermoformed article (15) with the respective extraction head or else with its respective receiving template to ensure correct positioning of the article during conveyance through the work or treatment stations.</p> <div data-bbox="893 1155 1477 1575"> </div>		

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"THERMOFORMING APPARATUS FOR THERMOFORMABLE  
MATERIALS IN RIBBON OR SHEET-FORM"

DESCRIPTION

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This invention generally relates to a thermoforming apparatus for thermoformable materials in ribbon or sheet-form.

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As is known in the art - see for example the patents of Applicant n°1 175 178 and n°1 218 634 - it has already been suggested to extract mouldings of thermoformed objects from a female die by using suction plates which are introduced between the male die and the female die of a thermoforming machine and then successively move away from the moulding area to deposit the articles onto an extracting or removal means for a series of intervening operations on the articles, such as stacking, labelling, etc.

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Also already proposed has been a thermoforming machine with a double female die arranged to be actuated in alternate transverse motion in relation to a male die, in which two suction hoods alternately extract a thermoformed-article moulding from a respective female die, to transfer it in sequence to a perforated jig forming part of a step conveyor having a plurality of jigs, each of which has holes dimensioned and arranged like the female cavities of the female dies where the articles were thermoformed. The conveyor is operatively connected to the thermoforming machine and moves at the pace of the operating rate of the thermoforming machine, and is intended to receive the articles immediately after the thermoforming process, to support them in the same reciprocal set as they occupied in female die, in order to prolong the time for the stabilisation of the material just thermoformed and allow the regular feeding of the thermoformed articles to a series of operating stations for intervention on the articles. Reference should be made to applicant's Italian patent application no 92A000012 filed 3 February 1992 and entitled: "Process and apparatus for the thermoforming and stacking of

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hollow bottom-provided articles obtained from a ribbon of thermoplastic material".

US patent 4 464 329 (Whiteside et al) discloses a thermoforming machine in which the plates of a plate-conveyor pass between a male die and a female die and are pressed between the two dies during the closure phase of the die and co-operate with an intermediate auxiliary die, which is mobile in relation to the female die. Each plate or jig is fitted with receiving seat for a moulded article and around the peripheral contour of such seat is provided a ring gasket of flexible material which serves to resiliently engage and keep the thermoformed article restrained in its position whether during the extraction of the article from the female die or during its transfer to an unloading station or removal from the conveyor.

The solutions proposed up to now, although satisfactory from many points of view, have not provided for the thermoformed article or articles to be held fast to a receiving template or jig forming part of the step conveyor operatively connected to the thermoforming machine, in which case, the thermoformed and not yet stabilized articles can undergo inertial shifting or removal from their reception seats, whereby they can lose the required precision of their positioning for successive operations or interventions on them.

It can be seen, in fact, in Figures 1 to 6 in the accompanying drawings show a truncated conical container with protruding rim such as a beaker 1, deposited in two different seats (through-holes) 2 and 3 (which latter is fitted with a peripheral recess 3a against which the rim 1a of the container can abut provided in a respective transfer plate or jig 4 and 5. As each plate or jig is speedily moved at the pace of the rate of operation of the thermoforming machine which produces the articles, the articles in the jig are repeatedly subjected to acceleration both while being moved forwards and stopped. Since the centre of gravity G of each article 1 is outside the plane of the lying position of the jigs 4 and 5, whenever the

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article undergoes an acceleration, it also undergoes an upturning momentum which tends to make the article tilt in relation to the vertical in proportion to the arm bG (Figs. 1 and 4). In view of the taper (angle  $\alpha$  - Fig. 2 and 5),  
5 such momentum can also give rise to a harmful banging either on the lateral wall of the container 1 in the process of stabilisation, or on its rim (Figs. 3 and 6) as also to undesirable bedding outside the axis, which almost always compromise the good result of successive operations and  
10 interventions on the container which must maintain a correct, unvarying set, either during the step- by-step transfer or while stationed at the various work stations.

In the case of the solution suggested in US patent 4 464 329, the extraction operations of the die are not kept  
15 separate from the positioning operation of the transfer plate or jig, the reason why recourse must be made to a three-piece die (male, female and auxiliary intermediate die) extremely complicated and costly to make and mobilize. Moreover, in the Whiteside et al. solution, during the  
20 moulding phase, the ring gasket is kept in contact with the hot edges of the thermoforming die, and thus the gasket is subjected to repeated thermal cycling, undergoes rapid ageing and loss of flexibility, and after a limited number of thermoforming cycles, can stiffen until it causes scoring  
25 or another form of damage to an article which has just come out of the thermoforming die and is not yet fully stabilized, and thus undoubtedly increasing the number of rejects (unless special and consequently very expensive material is used).

30 The main object of the present invention is to eliminate or drastically reduce the drawbacks often complained of in the thermoforming apparatus, thereby allowing either a rapid extraction of the thermoformed articles from the die or seating them in a stable set on templates or jig for  
35 successive removal and transfer to one or more treatment and/or work stations.

Another object of the present invention is to provide available a thermoforming apparatus fitted with a step

conveyor with templates or jigs for receiving the articles just extracted from the thermoforming dies and in the process of stabilisation, to enable them to be transferred to a plurality of work stations, while keeping their set intact.

These and further objects, which will become more apparent later, are achieved with a thermoforming apparatus comprising a thermoforming machine fitted with at least one female die and counter-die or male die reciprocally approachable and removable for the operations of closing, thermoforming and opening, a feeder suitable for feeding thermoforming material in ribbon or plate form between each die and counter-die, cutting means associated with the die and counter-die for cutting the ribbon or plate material immediately after the closure of the die and counter-die, at least one work or treatment station for the articles thermoformed in the or each die and counter-die, a plurality of extraction means to extract a thermo-formed article moulding from the female die and move away from the die to convey the extracted articles successively to the or each work or treatment station, or else to transfer it to a receiving template for being conveyed to the or each work or treatment station or stations, retention means suitable for engaging each thermoformed article with the respective extraction head or else to its respective receiving template, thus ensuring its positioning in the correct set during conveyance through the work or treatment station or stations.

Further aspects and advantages of the present invention will become more apparent from the following detailed description of some of the currently preferred embodiments thereof, given by way of indicative, although not exclusive examples only, with reference to Figures 7 to 53 of the accompanying drawings, in which:

Figure 7 is a schematic lateral elevation of a thermoforming machine provided with an extraction plate for the thermoformed articles and with an alternately moving conveyor having two coplanar templates;

Figure 8 is a partial top view of the female die of the thermoforming machine, the conveyor and the extraction plate of Fig. 7;

5 Figure 9 is a top view illustrating a carousel variant with four arms;

Figure 10 shows in schematic section and lateral elevation view a thermoforming machine fitted with extraction plate for thermoformed articles and with a chain conveyor (with despatch and return runs, parallel but moving  
10 in opposite direction) fitted with article receiving templates, moving in sequence, first in one direction (forward run) and then in the other (return run);

Figure 11 illustrates a partial top view of the female die of the thermoforming machine, the conveyor and the  
15 extraction plate of Fig. 10;

Figures 12 and 13 are, respectively, a lateral elevation view and a top section similar to those of Figures 10 and 11, but with a conveyor with templates mounted and trailed along two circular, coaxial and coplanar trackways;

20 Figures 14 and 15 are, respectively, a lateral elevation view and a top section similar to those in Figures 10 and 11, but with a carousel conveyor with three plates or templates which act either as extraction plates for the die or as conveyor;

25 Figure 16 shows a detail of a receiving seat for a thermoformed-article, provided in a template;

Figure 17 is a schematic front elevation view which illustrates a thermoforming machine with conveyor with templates mounted on chains, where the conveyor templates  
30 also act as extraction plates for the articles thermoformed by the die;

Figure 18 shows a detail in a magnified-scale of the conveyor template of Fig 17;

Figure 19 is a partial sectional view of a conveyor  
35 template with seat provided with retention collar and container seated therein;

Figure 20 illustrates a detail of the template of Fig 19 to an enlarged scale;

Figure 21 illustrates a partial sectional view of another conveyor template similar to that in Fig. 19, but also formed with an annular recess for receiving the rim of the container;

5        Figure 22 illustrates a detail in section and to an enlarged scale of Fig 21;

Figures 23 and 24 are top views illustrating possible shapes in circular, rectangular or quadrate topview of the container of Figures 19 and 21;

10       Figure 25 is a local sectional view which shows another embodiment of a template seat for thermoformed articles;

Figure 26 shows a sectional detail of Fig.25;

Figure 27 shows a sectional view of a further embodiment of a seat for a receiving template for thermoformed  
15       articles;

Figure 28 illustrates a detail of Fig. 27;

Figure 29 is a sectional view showing a template with a receiving seat provided with an adapter collar for retaining the container;

20       Figure 30 shows a detail of Fig. 29;

Figure 31 and 33 and the respective details of Figures 32 and 34, illustrate two embodiments of a conveyor template fitted with resilient means of restraint for thermoformed articles;

25       Figure 35 illustrates a partial sectional view of a receiving seat for a thermoformed article in a conveyor template with vacuum retention means;

Figure 36 shows a variant of Fig. 35;

30       Figure 37 is a sectional view showing a receiving seat of thermoformed articles fitted with resilient retention means;

Figure 38 shows a modification of Fig. 37;

Figures 39 and 40 are topviews illustrating a circular and a rectangular shape of thermoformed article of Figures 37 and 38;

35       Figure 41 shows a partial sectional view of another embodiment of a receiving seat for thermoformed articles of a conveyor template provided with mechanical retention means;



Figures 42 and 43 show details and variants of the plate or template of Fig. 41;

Figures 44 and 45 are topviews illustrating a circular and a rectangular shape of thermoformed article installable  
5 in the plates of Figures 41 to 43;

Figures 46 and 47 show two jig seats for a template conveyor slat for thermoformed articles with pneumatic means for retention in position;

Figures 48 and 49 show two partial sectional views of two  
10 different embodiments of a receiving seat for a thermoformed cover in a conveyor template;

Figure 50 shows a receiving seat of a conveyor template comprising a raised push rod;

Figure 51 shows a partial sectional view of a receiving  
15 seat with bearing recess for the rim of a thermoformed article;

Figure 52 illustrates a partial sectional view of a receiving seat in a conveyor template for thermoformed articles; and

20 Figure 53 shows a variant of Fig. 52.

In the accompanying drawings, the same or similar parts or components have been marked with the same reference numerals.

With reference first to the embodiment illustrated in  
25 Figures 7 and 8, schematically indicated by 10 is a thermoforming apparatus which comprises a base 11 on which is mounted a vertically mobile female die 12. Above the female die 12 there is provided, as is usual in thermoforming technology, a male die or counter-die 13,  
30 which in its turn, can be lowered and raised in relation to the female die and synchronously with it, to allow implementation of the required operations of closing and opening of the die, as well as cutting of the thermoformable material in ribbon or plate 14 being supplied by any  
35 suitable means between the dies 12 and 13 when they are in the open position.

The articles 15 (usually containers - beakers, cups, basins, lids and the like) obtained by thermoforming within

the female die 12, after the opening or reciprocal removal of the dies 12 and 13, must be withdrawn from the female die, which operation being facilitated by the provision of the extraction members E (one for each thermoformed article) rising from the base of the female die during the opening phase of the dies. The articles are detached from the die 12 using an extraction plate 16, for example, a suction plate as described in Italian patent no 1 175 178 and no 1 218 634 referred to above, which is actuated in phase with the removal rate of the dies 12 and 13 and extracts all the moulding articles present in the female die 12 and transfers them onto a jig or template 17 fitted with so many reception seats of holes 18, equivalent in number to the articles 15 constituting a moulding.

The templates 17 belong to a conveyor 19 with two templates alternately movable, once onto one side of the die 12 and once onto the other, so that a template is moved laterally in relation to the female die, while the other is in front of it ready to receive an article moulding from the extraction plate 16. In their lateral position, the templates 17 deliver the articles 15 to a handling and/or treatment station, for example, a sterilisation and stacking station for the articles.

The embodiment of Figure 9 relates to a carousel conveyor 20 comprising of four templates 17 positioned at 90° angles, to revolve in a pre-set direction of rotation for sequential positioning under extraction plate 16, to receive from it a moulding of articles 15 to be transferred.

Figures 10 and 11 illustrate an embodiment in which the templates 17 are positioned under a step conveyor 24 comprising two chains 25 which turn around respective chain wheels 26 at the ends of the conveyor and spanning which are mounted a plurality of templates 17 which are then arranged in an upper run 27 immediately below the operating path of the extraction plate 16 and a lower one 28, which moves in the opposite direction to the upper one. There can be provided a multiplicity of work and/or handling stations for the articles 15 arranged on the templates alongside the

conveyor 25 both along its upper run 27 and its lower run as well as at end wheels 26.

5 The variant shown in Figures 12 and 13 concerns a conveyor 29 comprising a single run, level but circular in shape, suitable for moving a plurality of templates 17 in sequence making them revolve stepwise, all in the same direction, under the extraction plate 16.

10 If desired, each template 17 can be easily mounted on a pair of fixed, circular, lateral trackways 30 and 31, for example, by means of two slides or carriages, respectively 32 and 33, and is restrained, typically by cable or chain or a suitable linkage means 34, either to the template preceding it or to the one following it on the circular conveyor 29. The template train is of course drawn in  
15 rotation by a step motor at a pace which will make the various templates stand in turn under the extraction plate 16.

The embodiment shown in Figures 14 to 16 relates to a carousel conveyor 35 with three arms 36, 120° apart, each of  
20 which supports a extraction plate 16 at its end. Each extraction plate 16, therefore, sequentially moves into three different operating positions, that is to say, one for extraction from between the opened dies 12 and 13, an intermediate one, where for example, the articles 15 are  
25 labelled or bored or otherwise processed or machined at a particular work station (not shown in the drawings), and a terminal (all positioned along the path of the extraction plate 16), where the same articles 15 are, for example, stacked in a stacking unit SA similar to that of Fig. 7.

30 As can be seen looking at Figure 16, the extraction plates 16 can also be of a different type from the suction one and can have receiving holes 16a machined along their thickness in order to present two annular inclined-plane surfaces 16a and 16b which delimit between them an  
35 equatorial shoulder 16d with an internal angle slightly undercut to be able to engage and firmly hold in position the free rim of a respective article 15.

The latter, while being raised by the extractor members E, is pushed to slide with its rim along the tapered surface 16b and to snap into engagement position with the shoulder 16d, and then conveyed along the operation path comprising the intermediate and the final station for the respective extraction plate 16. When at the final station, a slight thrust on the base of the container by a suitable thrusting device SP. (Fig. 14) will free the container from its receiving seat to then move to the stacker unit SA.

A similar structure is that illustrated in Figures 17 and 18, in which a plurality of extraction plates such as those in Figures 14 to 16 are mounted on a chain conveyor 37 of the type of conveyor 24, in which a run, for example, the upper run, extends between the dies 12 and 13 when they are in the open position and carries in step sequence the various plates 16, to be loaded with articles which are then carried in sequence to a predetermined number of work or handling stations.

Figures 19 to 24 illustrate a template 17, which, at each receiving hole 18 has in its far surface far from the extraction plate 16 a tapered collar 38, in which the articles 15 can precisely fall into seated position where they can thus abut with their rim either directly against the other surface of the template (Figs 19 and 20) or with a suitable annular recess 39, which assists in providing greater stability and accuracy in holding the articles 15 of both circular and square or rectangular topview configuration in the correct set.

As can be seen, in fact, the upturning momentum due to the arm bG and the inertial force at the centre of gravity G of the articles 15 is completely neutralized by shape engagement provided by the collar 38 and the thickness of the template having a total height h. In its turn, the height h is determined as a function of both the shape of the article 15 and the clearance g between the wall of the article and the internal diameter of the respective receiving seat 16a.

The embodiment shown in figures 25 and 26 concerns an adaptor collar 39 installable in each two-diameter receiving hole 18 a template 17 and having an internal diameter delimited by a higher tapered section 40, by an undercut intermediate section 41 with a negative angle  $\alpha$ , for example, from 3° to 10°, preferably, of approximately 5°, by an annular shouldering 42 at the undercut section, followed by a cylindrical end section 41. The articles 15 released by an extraction plate 16 are placed between a respective collar 39 and at their rim, slide along the tapered section 40 until they snap engage with the tapered section 40, in which they remain "resiliently constrained" in the correct position.

The templates 17 of Figures 27 to 30 have holes 18 fitted with a receiving tapered upper portion 44 and connected lower portion 45, but with an internal diameter slightly smaller than the external dimensions of the article 15 in the proximity of its rim. Also, in this case, the article 15 is "resiliently constrained" and therefore settled in stable fashion within the respective receiving hole, from which it can be upturned solely by the exercise of a sufficient thrust from below upwards.

Since there is no clearance  $g$  between the internal diameter of the receiving seat 18 in the template 17 and walls of the article 15, it is not necessary to provide any collar means to increase the thickness of the template 17.

The embodiment of Figures 31 to 34 is similar to those of Figures 19 to 22, except that the lower part 46 of the collar 38 consists of a deformable resilient material, suitably anchored to the collar and designed to exert a moderate pressure on the external surface of the article.

Figures 35 and 36 show holes for a vacuum pneumatic circuit (not shown and communicating with a suitable suction means) formed in the collar 38 and having the function of maintaining the thermoformed articles 15 in a stable set.

Figures 37 and 38 illustrate suitably shaped ratchets 48 installed in a collar 38 fitted at a preset distance from the template 17, in order to be able to move radially or

otherwise along a transverse plane (preferably perpendicular) with respect to the axis of the respective article 15 to be locked in position. The ratchets 48 are resiliently loaded, for example, by one or more springs 49.

5        Figures 39 to 45 show eccentric mechanical retainers 50, each of which is mounted at a respective receiving hole 18 on a template 17, and is movable, for example, by rotation around an axis normal to the template 17 to which it belongs, between an operating position in which it engages  
10       the rim of an article 15 and an inoperative release position. Actuation of the retainers 50 can be effected by means of a rack operated by a suitable motion source, such as a pneumatic jack, and an integral pinion 52 in rotation with a respective retainer 50.

15       Embodiment examples of Figures 46 and 47 concern retention means, generating air-jets 53 through a manifold CL, which exert a thrust pressure on the article 15 in correct set in the respective receiving seat 18 and with their rim abutting against the template 17.

20       Means of retention in position for covers 15 are illustrated in Figures 48 and 49 and comprise a bearing shouldering 57 in each receiving seat 18, which has two diameters, or else an annular protrusion 59 which engages the internal diameter of the flange 60 of the cover (Fig.  
25       49).

      Figures 50 and 51 show retention means for articles 15 kept inverted during transfer to the various work or treatment stations. Figure 50 illustrates a sort of push rod 61 which rises from a surface of the templates 17 at a  
30       dummy receiving seat 18a, while in Figure 51 the dummy receiving holes 18 annular slots 62 are provided, with which the free rim of an inverted article 15 will abut. The removal is effected, for example, by means of a push rod 56.

      Figures 52 and 53 illustrate cup retention means 54 with  
35       an orifice 55 at the base. The cup 54 is applied in similar way to a collar 38, to correspond with each receiving hole 18 of a template 17 for receiving and completely compassing an article 15 (even if not provided with a flanged or curled

rim), thus preventing any lateral shift, but with the possibility of easily expelling it from the cup 54 by acting with a push rod 56 through the orifice 55.

5 As will be seen with the technical solution, in accordance with the present invention a sure, steady, uniform positioning of the articles for an indefinite series of mouldings is ensured, so that on the same articles while they are in the process of stabilization, a certain number of finishing and/or embellishment operations with great  
10 precision and without turning out rejects.

The invention described above is susceptible to numerous modifications and variations within the protective scope of defined by the purview of the claims.

CLAIMS

1. A thermoforming apparatus comprising a thermoforming machine (10) fitted with at least one female die (12) and counter-die or male die (13) reciprocally approachable and removable for the operations of closing, thermoforming and opening, a feeder appropriate for feeding thermoforming material in ribbon or plate (14) form between each female die (12) and counter-die (13), cutting means associated with the die and counter-die for cutting the ribbon or plate material, immediately after the closure of the die (12) and counter-die (13), at least one work or treatment station for articles (15) thermoformed in the or each die (12) or counter-die (13), extraction pick-up means (16) designed to withdraw a thermoformed article moulding from the female die (12) and either to convey the same to one or more work or treatment stations or to transfer it to a receiving conveying template (17) which has the same seating configuration as that of the female die (12) and is arranged to move the thermoformed articles (15) past one or more work treatment stations, means of retention suitable for engaging each thermoformed article with the respective extraction head or with the respective receiving template, thus ensuring its positioning in correct set during conveyance through the work or treatment station or stations.

2. A thermoforming apparatus as claimed in Claim 1, characterised in that the said pick-up extraction means comprises a plate-like head (16) arranged to be sequentially inserted between the or each female die (12) and counter-die (13) concomitantly with each opening of the same.

3. A thermoforming apparatus as claimed in Claim 2, characterised in that it comprises a carousel conveyor (20) with a plurality of bearing arms, each of which supports a respective plate-like head (17) fitted with said retention means for the retention of the thermoformed articles (15) in the correct set while they are being conveyed, stepwise and synchronously with the opening-closing rate of the dies



(12), through the work or treatment station or stations, positioned around the carousel conveyor.

4. An apparatus as claimed in Claim 3, characterised in  
5 that the said retention means for each plate-shaped  
extraction head (17) comprises a hole or seat through the  
said plate-shaped extraction head for each thermoformed  
article to be extracted, each hole being machined along its  
thickness to obtain two annular surfaces reamed in opposite  
10 directions and delimiting between them an equatorial  
shoulder (16d) with a slightly undercut, internal angle of  
incidence, in order to allow insertion by the thrust of a  
rimmed thermoformed article (15) and enable it to be  
resiliently constrained and held firmly in position at its  
15 rim.

5. A thermoforming apparatus as claimed in Claim 2,  
characterized in that it comprises a chain or chains  
conveyor (24) each wound by a pair of chain wheels and  
20 having a run (27) thereof extending along the respective die  
(12) or counter-die (13) but beyond the encumbrance thereof,  
a plurality of extraction plates (16) carried at  
predetermined intervals from each other on the said conveyor  
(24) and each fitted with the said retention means for  
25 retaining the thermoformed articles (15) in the proper set  
during their conveyance.

6. A thermoforming apparatus as claimed in Claim 1 or 2,  
characterized in that it comprises a template conveyor (24)  
30 extending through the work or treatment station or stations  
and moving stepwise at the opening-closure rate of the dies  
(12) for receiving a moulding or thermoformed articles (15)  
from an extraction plate (16) and conveying them in sequence  
to the work or treatment station or stations along the  
35 template conveyor (24).

7. A thermoforming apparatus as claimed in Claim 6,  
characterized in that the said template conveyor (24)

comprises two alternately movable templates (17), once on one side of the die (12) and once on the other, so that a template (17) is moved laterally in relation to the female die (12) at a work or treatment station, while the other one is in front of it to receive an article moulding from the extraction plate (16).

8. A thermoforming apparatus as claimed in Claim 6, characterized in that the said template conveyor (24) is a chain or chains conveyor which comprises a pair of chain wheels (26) around which the or a respective chain (25) is wound, a plurality of plate-like templates (17) carried, spaced at a predetermined distance from each other, on the said conveyor (24) and each fitted with the said retention means for retaining the thermoformed articles (15) in the proper set during their conveyance.

9. A thermoforming apparatus as claimed in Claim 5, characterized in that the said template conveyor (24) comprises a train of articulated bearing slides (32) or carriages (33) for a respective template (17) moving through the work or treatment station or stations.

10. A thermoforming apparatus as claimed in any of Claims 6 to 9, characterised in that the said retention means on each template comprises a truncated conical collar (38) seated in each receiving hole for precise location of a respective thermoformed article (15) on the surface of each template (17) facing the extraction plate of plates (16).

11. A thermoforming apparatus as claimed in Claim 10, characterised in that the said collar (38) is constituted of resiliently deformable material suitable for exercising a moderate retentive pressure on the external surface of a thermoformed article (15).

12. A thermoforming apparatus as claimed in Claim 10, characterised in that the said collar (38) comprises a

plurality of resiliently loaded ratchets (48), installed in said collar and movable towards its internal diameter for engaging with the external surface of a thermoformed article (15) in a respective receiving seat.

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13. A thermoforming apparatus as claimed in Claim 10, characterised in that the said collar (38) comprises suction orifices which exert on the thermoformed article (15) a suction action to hold it in the proper set in its  
10 respective receiving seat and with its rim abutting against the template (17).

14. A thermoforming apparatus as claimed in any of Claims 10 to 13, characterised in that each template (17) at each  
15 flanged receiving set for thermoformed rimmed articles (15) has a peripheral recess formed on the surface of the template (17) facing the extraction plate or plates (16) for engaging the rim of a respective article (15) installed in it.

20

15. A thermoforming apparatus as claimed in any of Claims 6 to 9, characterised in that the said retention means for each template (17) comprises a two-diameter adaptor collar (39) installable in each receiving seat and having an  
25 internal diameter delimited by a tapered under section, and undercut intermediate section with a negative angle  $\alpha$ , an annular shoulder downstream of the undercut section, to be able to receive from above a flanged thermoformed article (15) and snap-engage its rim at its undercut.

30

16. A thermoforming apparatus as claimed in any of Claims 6 to 9, characterised in that the said retention means for each template (17) comprises receiving holes for the thermoformed articles lower portion, but with a slightly  
35 smaller internal diameter than the external dimensions of the thermoformed articles (15) to be received close to its rim, so that the thermoformed article (15) is resiliently

constrained and then steadily bedded in the respective receiving hole.

17. A thermoforming apparatus as claimed in any of Claims 6  
5 to 9, characterised in that the said retention means of each  
template (17) comprises eccentric mechanical arrests (50),  
each of which is fitted at a respective receiving hole of a  
template (17) and is movable between an operating position  
in which it engages the rim of a flanged thermoformed  
10 article (15) and an inoperative releasing position.

18. A thermoforming apparatus as claimed in Claim 17,  
characterised in that the said arrests are controlled by a  
rack operated by a suitable motion source.

19. A thermoforming apparatus as claimed in any of Claims 6  
to 9, characterised in that the said retention means  
comprises air jets (53) for sinking each of the articles  
(15) into the receiving holes on each template (17).

20. A thermoforming apparatus as claimed in any of Claims 6  
to 9, characterised in that the said retention means  
comprises a cup-shaped receiving component (54, 61) for a  
thermoformed article (15) having at least one orifice in its  
25 base.

21. A thermoforming apparatus as claimed in Claim 21,  
characterised in that it comprises a push rod (56) for  
expelling the thermoformed article (15) from the cup-shaped  
component (54, 61) by acting through at least one orifice  
30 (55) in the bottom of the cup-shaped component.

22. A thermoforming apparatus as claimed in any one of  
Claims 6 to 9, characterised in that the said retention  
means comprises a support shoulder for shallow, thermoformed  
35 articles arranged between each receiving seat of the  
template (17), the said shoulder having two diameters or

else including an annular projection which engages the internal diameter of the rim of the article.

5 23. A thermoforming apparatus as claimed in any of Claims 6 to 9, characterised in that the said retention means comprises a push-rod which rises from a surface of each template (17) to a respective dummy receiving seat.

10 24. A thermoforming apparatus as claimed in any of Claims 6 to 9, characterised in that the said retention means comprises at least one annular recess, in which the free rim of an upturned hollow article (15) abuts and a movable push road (56) for removal of the article (15).

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FIG. 1

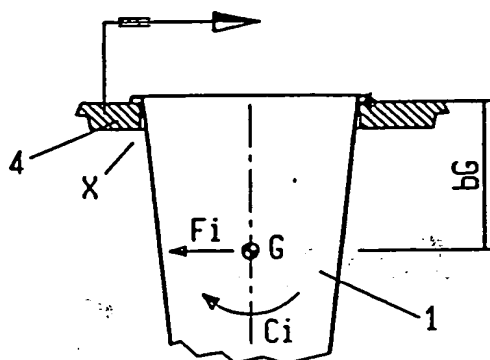


FIG. 2

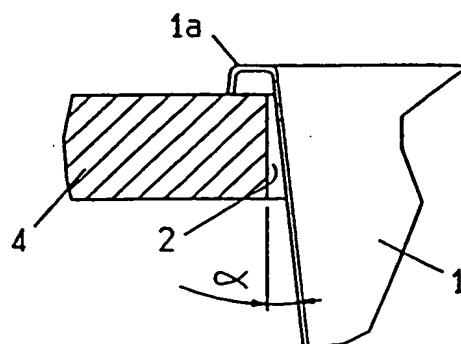


FIG. 3

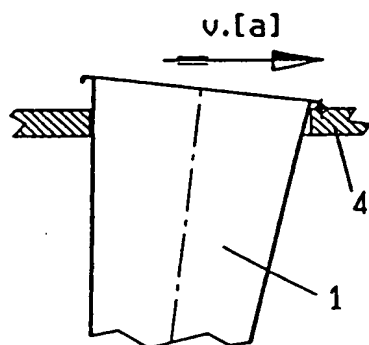


FIG. 4

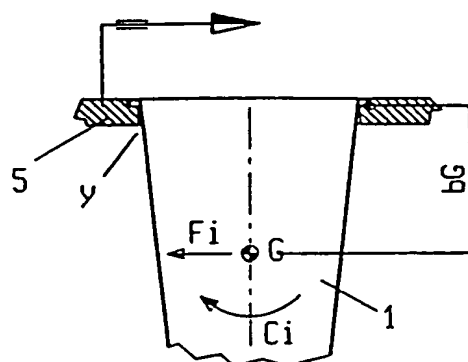


FIG. 5

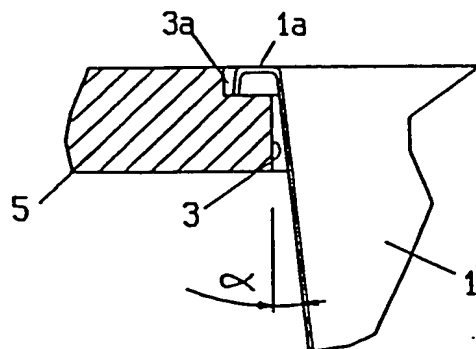
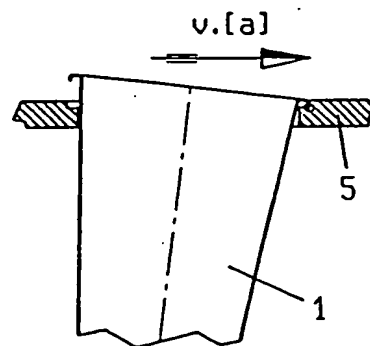


FIG. 6



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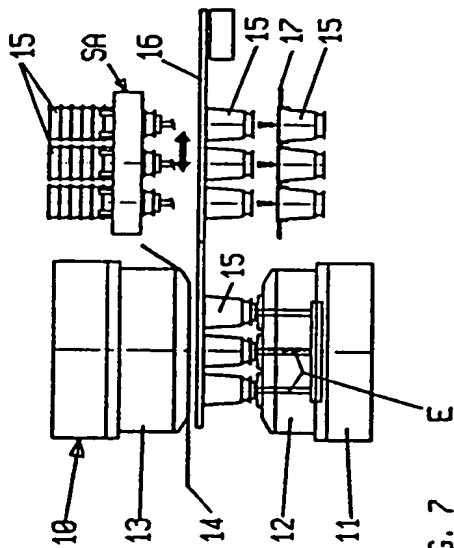


FIG. 7

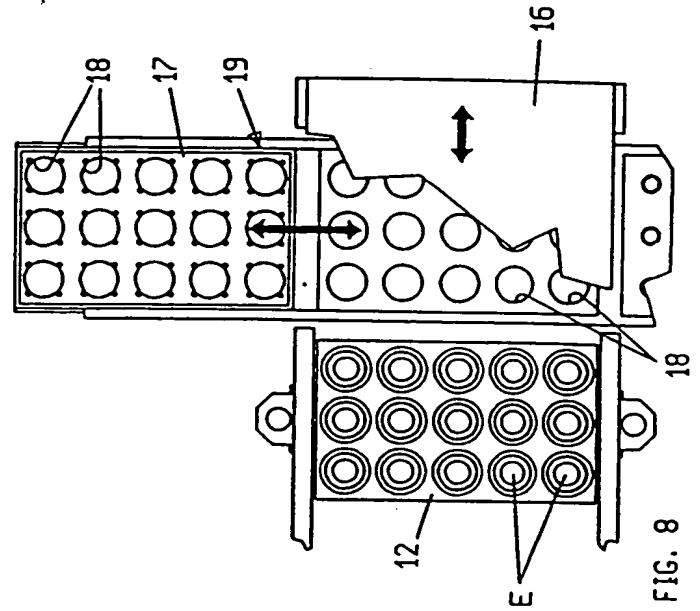


FIG. 8

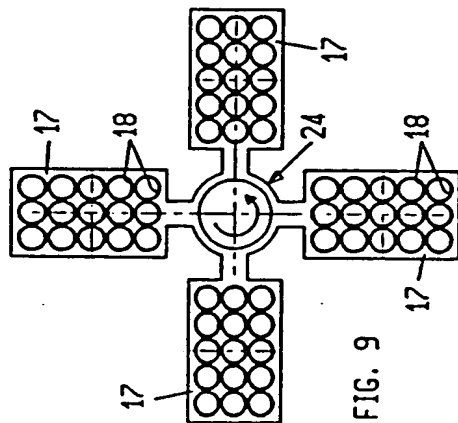


FIG. 9

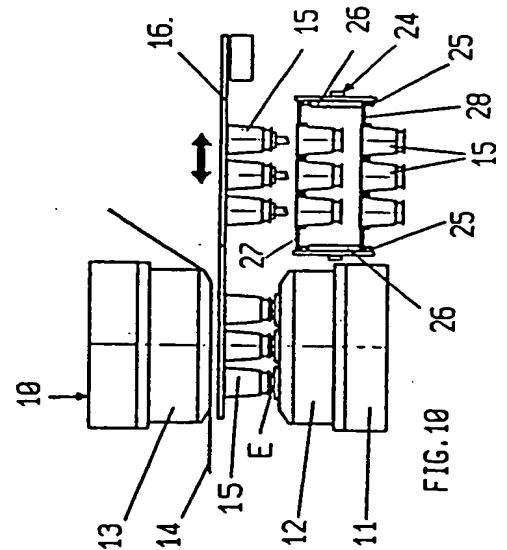
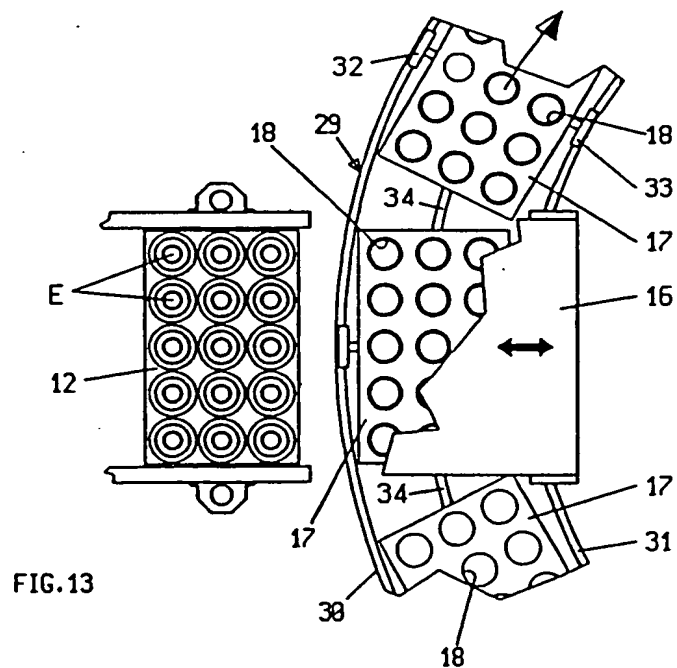
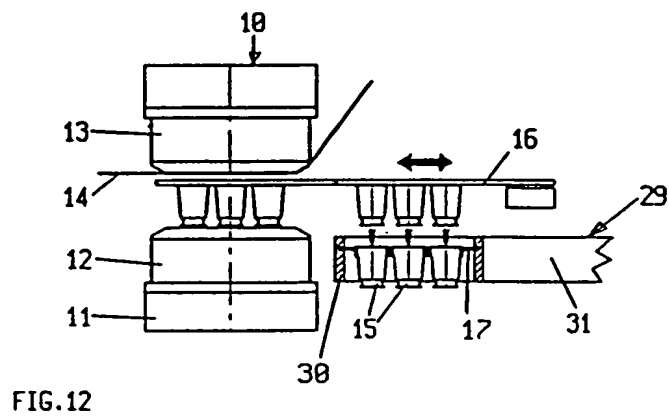
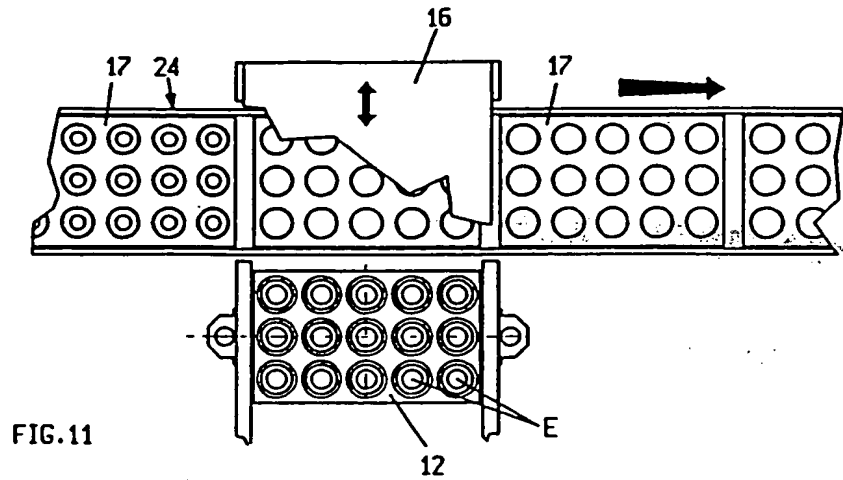


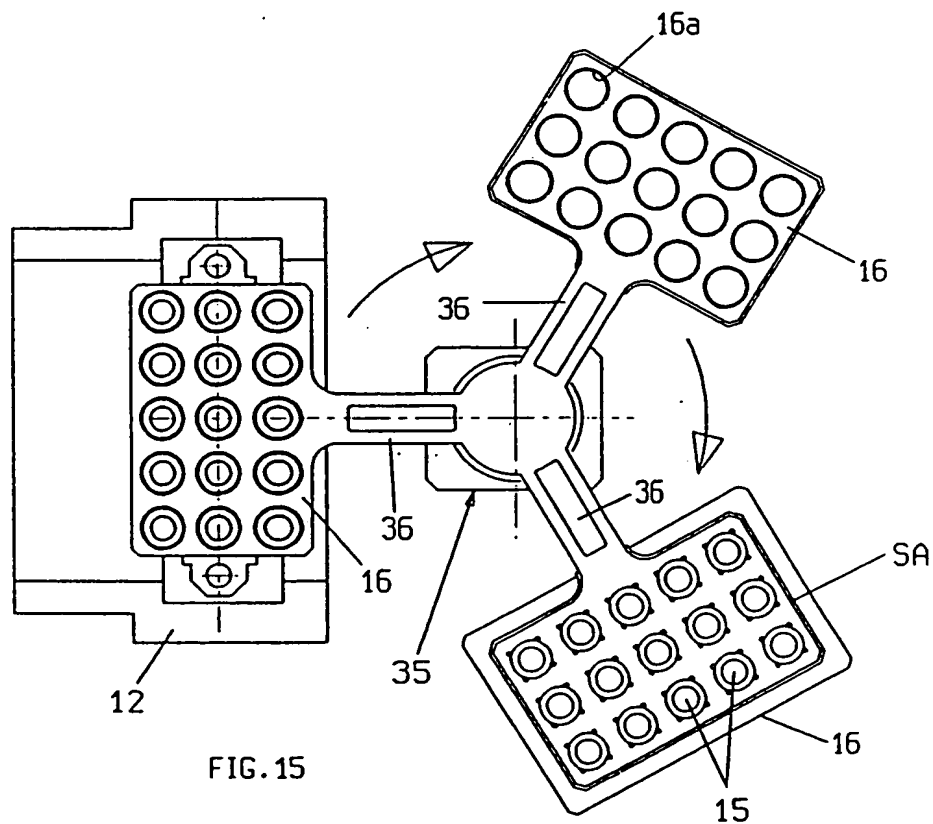
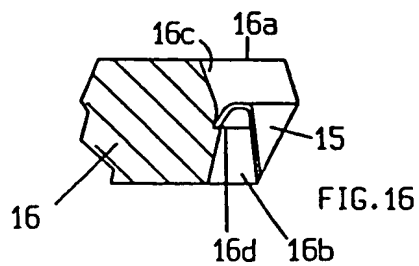
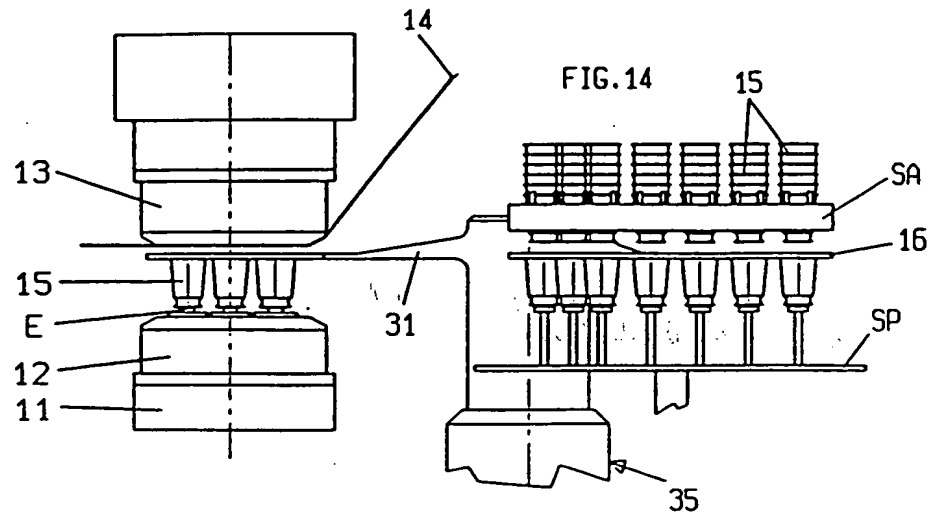
FIG. 10

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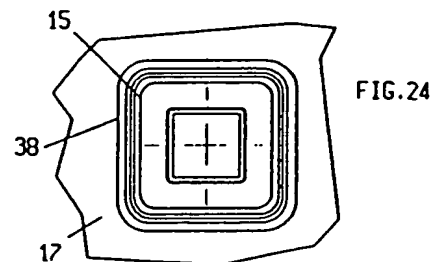
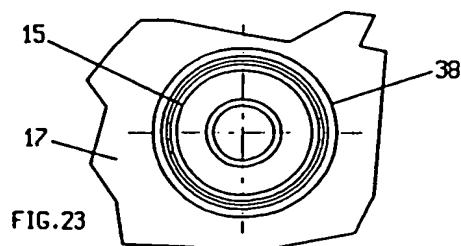
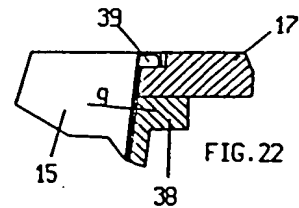
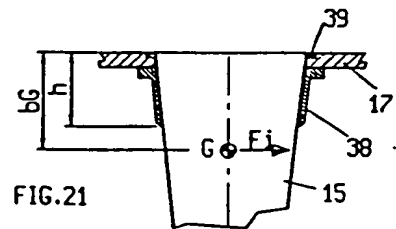
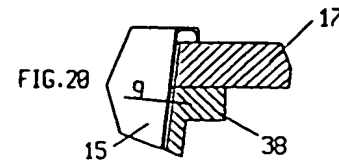
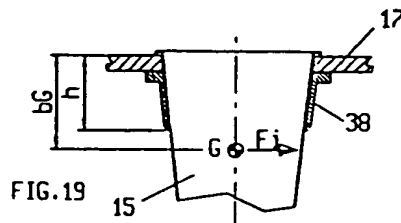
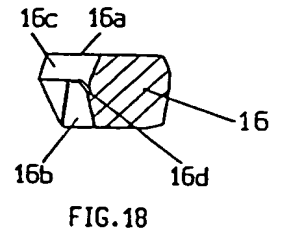
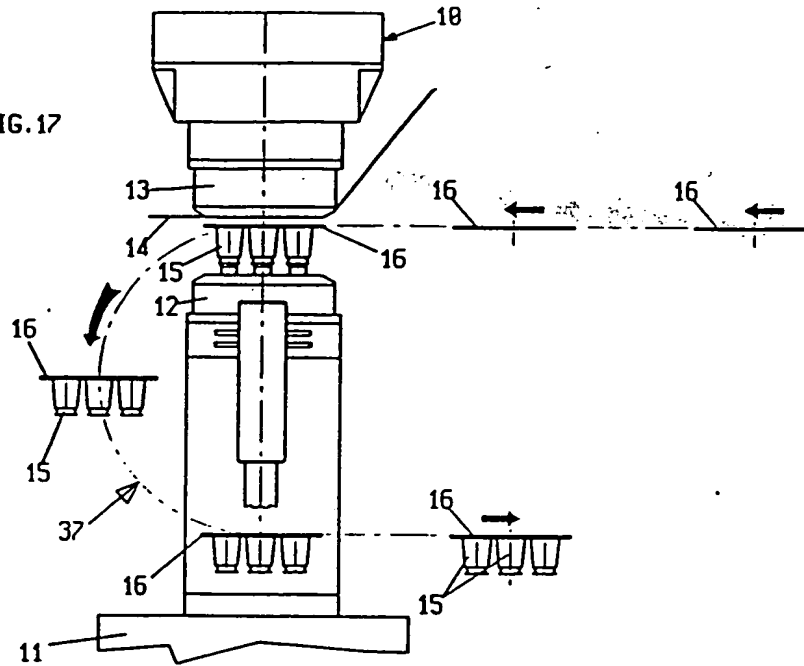
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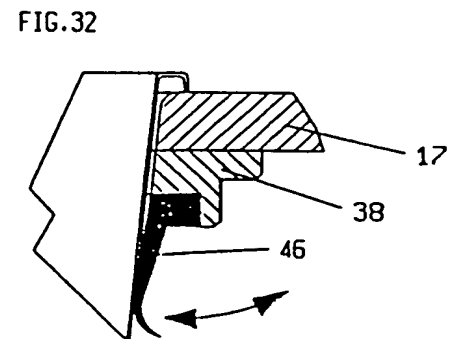
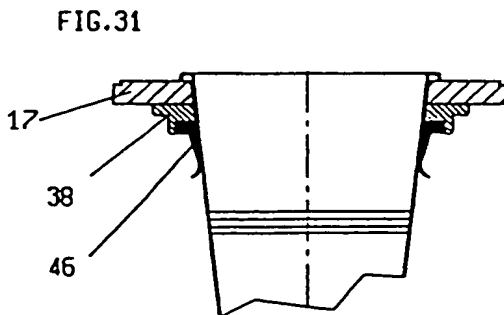
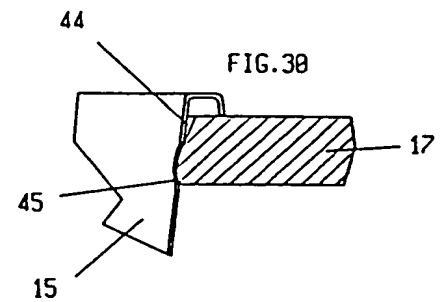
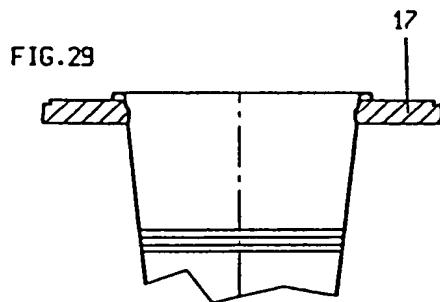
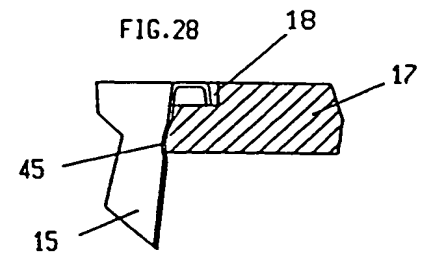
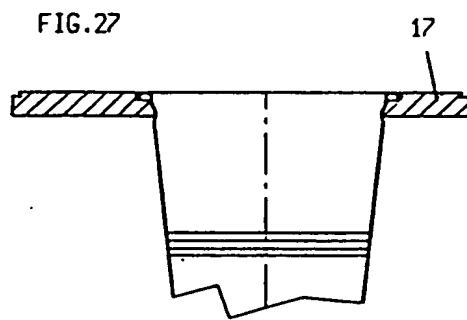
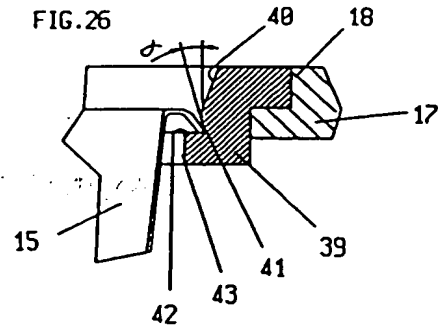
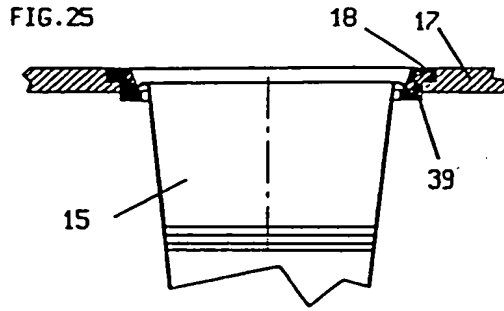
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FIG. 17



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FIG.33

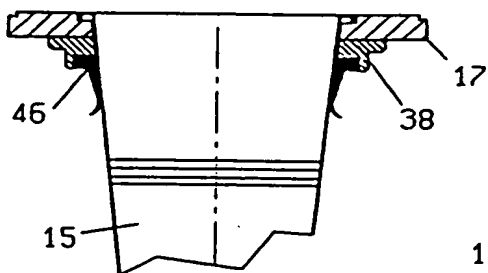


FIG.34

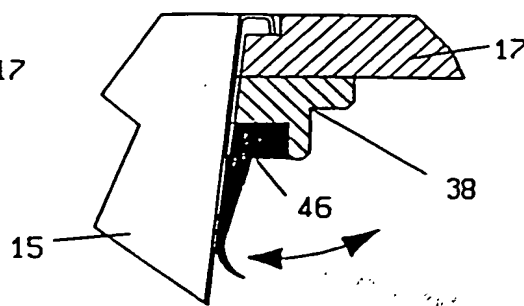


FIG.35

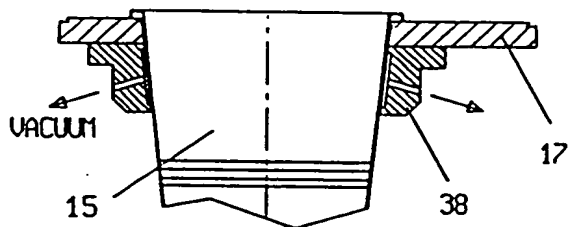
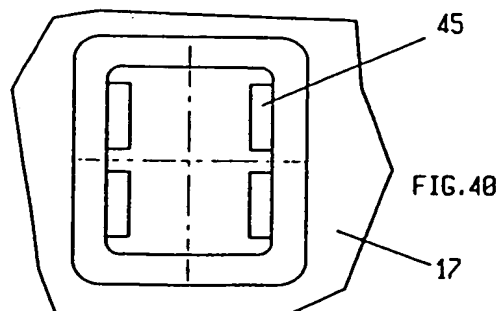
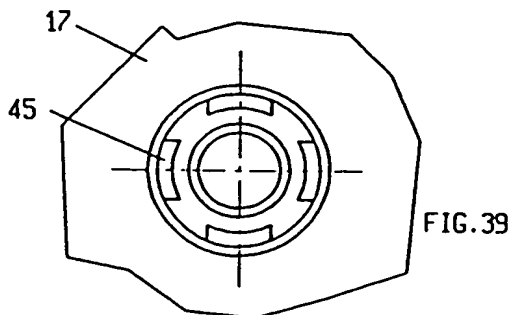
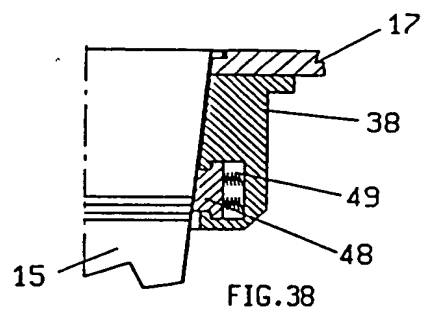
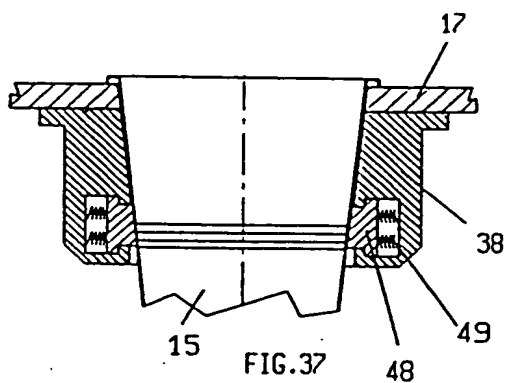
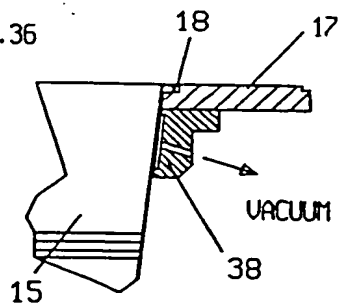
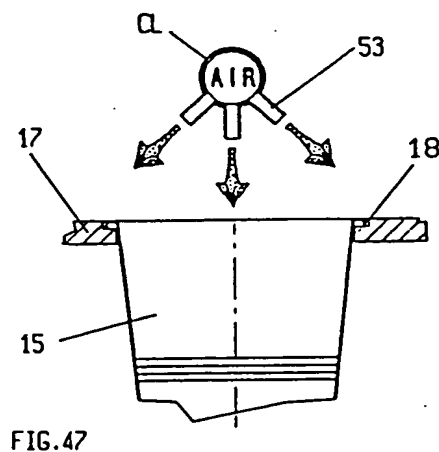
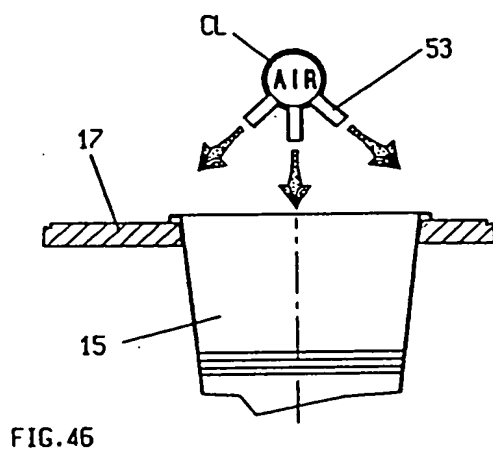
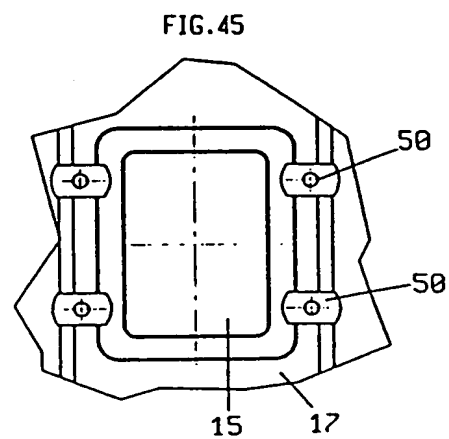
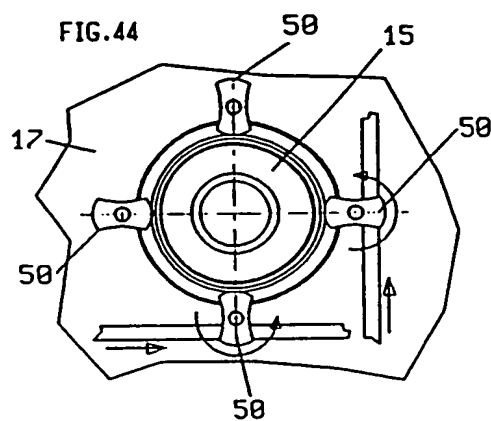
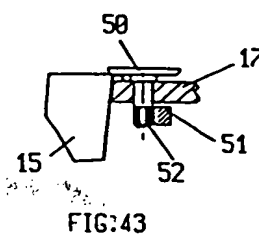
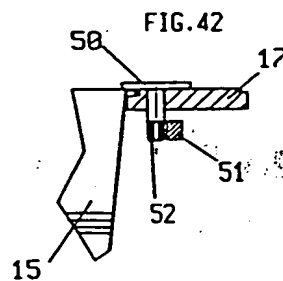
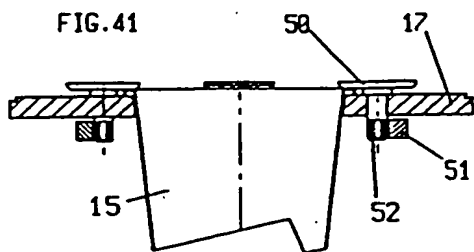


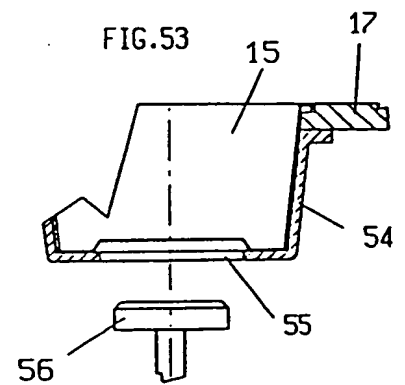
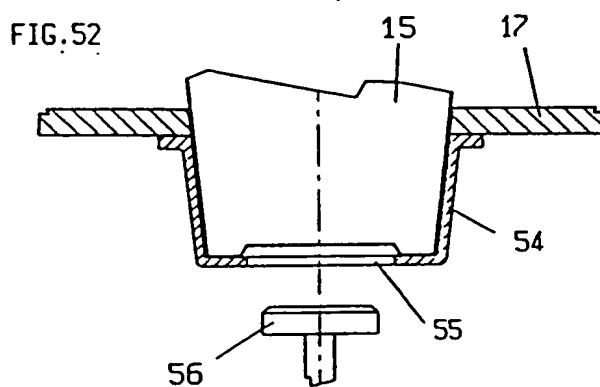
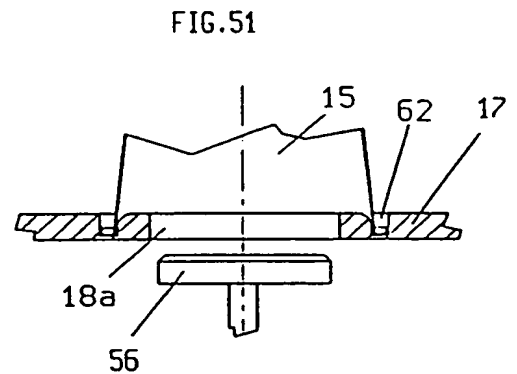
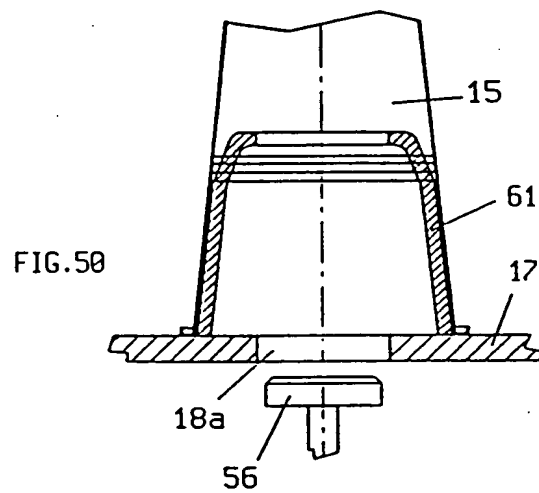
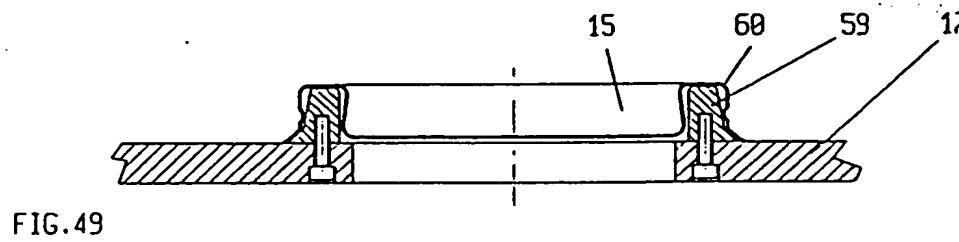
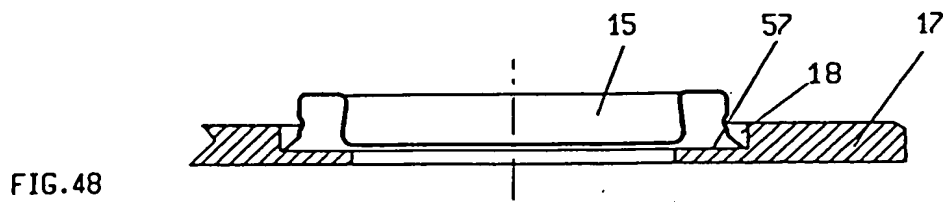
FIG.36



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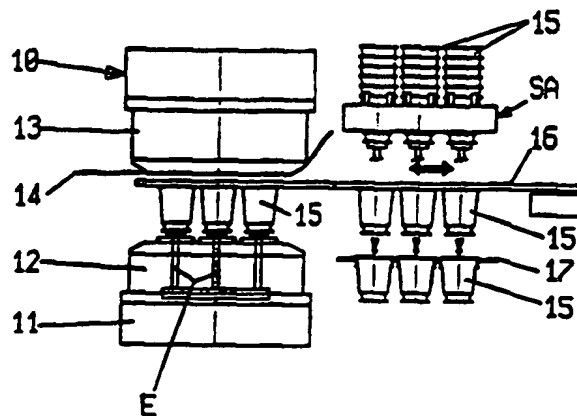
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification n<sup>o</sup> :</b> <b>B29C 51/44</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 96/08357</b> <b>(43) International Publication Date:</b> 21 March 1996 (21.03.96)
<b>(21) International Application Number:</b> PCT/EP95/03451 <b>(22) International Filing Date:</b> 1 September 1995 (01.09.95) <b>(30) Priority Data:</b> VR94A000082 14 September 1994 (14.09.94) IT <b>(71) Applicant (for all designated States except US):</b> ISAP OMV GROUP SPA [IT/IT]; I-37025 Parona Verona (IT). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> PADOVANI, Pietro [IT/IT]; Via Carlo Ederle, 43, I-37100 Verona (IT). <b>(74) Agent:</b> FITZPATRICKS; 4 West Regent Street, Glasgow G2 1RS (GB).		<b>(81) Designated States:</b> AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** THERMOFORMING APPARATUS FOR THERMOFORMABLE MATERIALS IN RIBBON OR SHEET-FORM

**(57) Abstract**

A thermoforming apparatus comprising a thermoforming machine (10) having a female die (12) and counter-die or male die (13) reciprocally approachable and removable for the operations of closing, thermoforming and opening, a feeder of thermoforming material between the female die (12) and counter-die (13), cutting means for cutting the thermoforming material immediately after the closure of the female die and the counter-die, one or more work or treatment stations for the articles (15) thermoformed in the die (12), extraction heads (16) arranged to be operated concomitantly with each opening of the same to extract a thermoformed article (15) moulding from the female die and to convey the articles thus extracted to one or more work or treatment stations or else to transfer them to a receiving template (17), retention means for engaging each thermoformed article (15) with the respective extraction head or else with its respective receiving template to ensure correct positioning of the article during conveyance through the work or treatment stations.



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## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/ 95/03451A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 B29C51/44

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B29C B65G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB,A,2 263 660 (VERONESI OFF MEC) 4 August 1993 see abstract; figures 7-33 ---	1,2, 5-10,13
X	DE,A,39 28 301 (ILLIG MASCHINENBAU ADOLF) 28 February 1991 see column 1, line 62 - column 2, line 36; claims; figures ---	1,2
X	WO,A,94 15863 (ISAP OMV GROUP SPA ;PADOVANI PIETRO (IT)) 21 July 1994 see abstract; figures ---	1,2
A	GB,A,2 149 717 (OMV SPA OFF MECC VERONESE) 19 June 1985 see abstract; figures 1-11 ---	1-16
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Date of the actual completion of the international search

4 January 1996

Date of mailing of the international search report

08.02.96

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A	US,A,4 807 421 (ARAKI KAZUNORI ET AL) 28 February 1989 see figures ---	10, 16
A	US,A,4 684 012 (FEDDERSEN FREDERICK J) 4 August 1987 see figures ---	10
A	US,A,2 992 454 (L. E. ELPHEE) 18 July 1961 see figures ---	16
A	EP,A,0 220 967 (REMY & CIE E P) 6 May 1987 see figures ---	
A	FR,A,2 416 856 (POULLAIN BERNARD) 7 September 1979 see figures -----	

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## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 95/03451

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-2263660	04-08-93	AU-B- 655344	15-12-94
		AU-B- 3206793	05-08-93
		BE-A- 1005832	15-02-94
		BG-A- 97364	25-04-94
		CA-A- 2087512	04-08-93
		CN-A- 1093644	19-10-94
		CZ-A- 9300122	19-01-94
		DE-A- 4224009	05-08-93
		EP-A- 0554799	11-08-93
		ES-A- 2068741	16-04-95
		FR-A- 2686827	06-08-93
		GR-A- 93100034	29-10-93
		HU-A- 66824	30-01-95
		JP-A- 6293063	21-10-94
		LU-A- 88216	17-05-93
		NL-A- 9201383	01-09-93
		PT-A- 101192	30-06-94
		SE-A- 9202260	04-08-93
		TR-A- 26597	15-03-95
		US-A- 5453237	26-09-95
		ZA-A- 9300704	06-09-93
-----			
DE-A-3928301	28-02-91	NONE	
-----			
WO-A-9415863	21-07-94	AU-B- 5815394	15-08-94
		CA-A- 2153766	21-07-94
		CN-A- 1093973	26-10-94
		EP-A- 0679141	02-11-95
		NO-A- 952723	25-08-95
-----			
GB-A-2149717	19-06-85	AT-B- 392234	25-02-91
		AU-B- 558959	12-02-87
		AU-B- 3516484	30-05-85
		BE-A- 901010	08-05-85
		CA-A- 1232423	09-02-88
		CH-A- 663571	31-12-87
		DE-A- 3439660	23-05-85
		FR-A, B 2557017	28-06-85
		JP-C- 1520740	29-09-89
		JP-A- 60132730	15-07-85

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Information on patent family members

International Application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-2149717		JP-B- 63065494	15-12-88
		NL-A, C 8403480	03-06-85
		SE-B- 465415	09-09-91
		SE-A- 8405703	16-05-85
		SU-A- 1378778	28-02-88
		US-A- 4560339	24-12-85
-----			
US-A-4807421	28-02-89	JP-B- 6032366	27-04-94
		JP-A- 62021296	29-01-87
		JP-A- 62028353	06-02-87
		JP-A- 62106278	16-05-87
		EP-A, B 0209064	21-01-87
		EP-A, B 0291674	23-11-88
-----			
US-A-4684012	04-08-87	US-A- 4763778	16-08-88
		AU-B- 563403	09-07-87
		AU-B- 3541384	09-01-86
		CA-A- 1234549	29-03-88
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US-A-2992454	18-07-61	NONE	
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EP-A-0220967	06-05-87	FR-A- 2589133	30-04-87
		FR-A- 2591575	19-06-87
		CA-A- 1259942	26-09-89
		DE-A- 3660897	17-11-88
		JP-B- 6104483	21-12-94
		JP-A- 62100308	09-05-87
		US-A- 4697695	06-10-87
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FR-A-2416856	07-09-79	NONE	
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